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Recruiting Goals, Regime Shifts, and the Supply of Labor to the Army

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THIS PAPER EXTENDS THE EXISTING LITERATURE ON MILITARY-LABOR SUPPLY IN THREE WAYS. FIRST, USING CPS DATA, IT DEVELOPS A MORE ACCURATE ESTIMATE OF THE ALTERNATIVE WAGE FACED BY YOUNG MEN. SECOND, IT ENDOGENIZES THE HIGH-QUALITY GOAL FACED BY RECRUITERS. AS THE UNITED STATES ARMY RECRUITING COMMAND BECAME INCREASINGLY BETTER AT SETTING THIS GOAL DURING THE 1980'S, THE ASSUMPTION THAT THE GOAL WAS EXOGENOUS TO THE RECRUITING PROCESS BECAME INCREASINGLY SUSPECT. THIS PAPER PRESENTS EVIDENCE THAT THE GOAL IS INDEED ENDOGENOUS. FINALLY, IT PRESENTS ESTIMATES BASED ON A SWITCHING SIMULTANEOUS-EQUATIONS STATISTICAL SPECIFICATION THAT ALLOWS BEHAVIOR TO VARY ACROSS RECRUITING ENVIRONMENTS TO REFLECT THE ASYMMETRIC INCENTIVES FACED BY RECRUITERS. THE FINDINGS SHOW THAT THE ESTIMATES OF THE PARAMETERS WITH THE GREATEST POLICY CONTENT ARE SENSITIVE TO EACH OF THESE SPECIFICATION ISSUES.

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RECRUITING GOALS, REGIME SHIFTS, AND THE SUPPLY OF LABOR TO THE ARMY

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ABSTRACT

This paper extends the existing literature on military-labor supply in three ways. First, using CPS data, it develops a more accurate estimate of the alternative wage faced by young men. Second, it endogenizes the high-quality goal faced by recruiters. As the United States Army Recruiting Command became increasingly better at setting this goal during the 1980's, the assumption that the goal was exogenous to the recruiting process became increasingly suspect. This paper presents evidence that the goal is indeed endogenous. Finally, it presents estimates based on a switching simultaneous-equations statistical specification that allows behavior to vary across recruiting environments to reflect the asymmetric incentives faced by recruiters. The findings show that the estimates of the parameters with the greatest policy content are sensitive to each of these specification issues.

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Key Words: Military Manpower, Switching Simultaneous Equations, Youth Wages, Recruiting Incentives

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The military is currently experiencing a period of enormous turbulence and uncertainty. The reductions in military spending that are scheduled to occur over the next several years will be accompanied by a 30% reduction in the size of the military. At the end of this period, the active Army alone will have shrunk by more than 250,000 soldiers from its mid-1980's level. As a result of these shifts, the Services are experiencing a period in which their need for new personnel has been dramatically reduced. But even in this environment, the Services will spend approximately $1.5 billion during 1993 to recruit personnel. Furthermore, because the Services chose to achieve current force reductions in part by reducing accessions below the numbers required to sustain even the smaller future end-strengths, the number of annual recruits will rise substantially as the Services approach their target end-strengths in the mid-1990's. Table 1 illustrates these trends for Army accessions.

In an environment of shrinking resources, the Services must ensure that they reap the full benefit of their spending. In the area of military manpower, this will require, among other things, a clear understanding of the military labor market, of the effectiveness of various incentives, and the relation between policy and recruiting effectiveness. In this paper, we present new insights on labor supply to the Army and the linkages between institutional incentives and the effectiveness of recruiting resources.

There have been two previous generations of empirical models of labor supply to the military. The first generation consisted of regression models based on time-series or aggregate panel data and lacked a rigorous theoretical foundation (Fisher (1969), Jehn and Shughart (1976), Fernandez (1979), Ash, Udis, and McNown (1983)). Models of this type

culminated in Brown's (1985) careful analysis. The second generation of models focused on the institutional environment and how that environment might affect the behavior of the recruiters, whose job is selling prospective enlistees on joining the military. These models are characterized by the work of Polich, Dertouzos, and Press (1986) and Daula and Smith (1986). Although both of these models focus on the role of the institutional environment, they differ in their approach. Polich, Dertouzos, and Press (1986) specify an equilibrium model, while in Daula and Smith the institutional setting leads to a switching equation formulation. In this paper, we extend these analyses and formally test whether an equilibrium model adequately characterizes this market. We find that the incentive structure does matter, that the goal setting or demand side of the market must be modelled as being endogenous, and that we can reject an equilibrium formulation in favor of a specification that allows behavior to differ across recruiting environments.

To present these findings, we have organized this paper into four sections. In Section I, we describe the institutional environment and derive our empirical specification. Section II contains a description of our data and the process by which we created some of our variables, most notably our civilian wage variable. Section III reports our estimation results and examines their implications for the specification of models of labor supply to the Army. Section IV contains our conclusions and makes recommendations for further research.

I. MODEL SPECIFICATION

Following the dismal recruiting results of the late 1970's, the Army undertook a two-part strategy for increasing the quality of enlisted accessions. This strategy consisted of

increased funding for enlistment incentives and the introduction of major reforms in recruiting. An important component of these reforms was the introduction of a marketing system whereby recruiters were assigned specific quotas for recruits by quality group. For the first time, recruiters were asked to obtain a certain number of high-quality personnel rather than simply to enlist able bodied personnel.[1] This system, which remains in place today, provides clear incentives that affect recruiter behavior and represents the demand side of the market.

A Simple Model of Recruiter Behavior and the Supply of Recruits

Following Polich, Dertouzos, and Press (1986), we model this process by assuming that recruiters act to maximize their utility subject to a technical constraint that reflects labor market conditions. That is, recruiters behave so as to

$$\begin{aligned} \max_{E,H,L} \quad & E^{\delta_1} + (H/Q_H)^{\delta_2} + \delta_4 (L/Q_L)^{\delta_3} \\ \text{s.t.} \quad & \ln(H) = \lambda \ln(L) + X\beta + \ln(E) \;, \end{aligned} \tag{1}$$

where H represents high-quality recruits, L represents low-quality recruits, E represents recruiter effort, Q_H and Q_L are the recruiter's "quotas" for high- and low-quality contracts, respectively, and X represents environmental and incentive variables that affect labor supply. We expect that $\lambda < 0$, $\delta_1 < 0$ and $0 < \delta_3 < \delta_2 < 1$. This formulation parsimoniously captures the most salient features of the recruiting environment: individuals are evaluated on their performance relative to assigned goals; the Army leadership places very different values on high- and low-quality recruits; and although some low-quality recruits are desired, the

Recruiting Command does not allow over-production of low-quality contracts to offset under-production of high-quality contracts. Thus, following Dertouzos (1985), we capture the effect of these incentives by modeling preferences so that the marginal utility of an additional contract is separable across contract types, varies by type of contract, and is a function of the magnitude of contract achievement relative to goals. Also, because low-quality contracts are used to smooth the workload of the training base, their value to the Army and, therefore, to the recruiter varies systematically over the year. The time-varying parameter, δ_t, is included to reflect this fact.

Although effort is unobserved, we can use the maximization problem described by equation 1 to solve for effort in terms of the other, observable variables. Solving for effort in terms of the other variables and then substituting for effort in the first-order conditions, we obtain the following system of equations

$$\ln(H) = \alpha \ln(L) + X_1 \beta_1 + \gamma_{11} \ln(Q_H) + \epsilon_1 \tag{2}$$

$$\ln(L) = \Theta_t + X_2 \beta_2 + \gamma_{21} \ln(Q_H) + \gamma_{22} \ln(Q_L) + \epsilon_2 \tag{3}$$

Applying our preceding assumptions about the signs and relative magnitudes of the δ parameters to equations 2 and 3, we expect that $\alpha < 0$ and $\gamma_{ij} > 0 \ \forall \ i,j$. Equations 2 and 3 are of central importance to the analysis of a variety of resource allocation and accession-policy issues, and the consistent estimation of the parameters contained in them will be the focus of this paper.

The Determination of Recruiting Missions

Previous studies either have ignored the potential effect of missions assigned to recruiters (Fernandez (1979), Ash, Udis, and McNown (1983), Brown (1985)) or have treated these missions as exogenous to the recruiting process (Dertouzos (1985), Polich, Dertouzos, and Press(1986), Daula and Smith (1986)). Under current procedures for assigning recruiting missions, the mission or goal for high-quality recruits assigned to a recruiting organization is predominantly based on consensus forecasts of market potential. Therefore, the high-quality goal variable may be correlated with the error terms in the structural equations for the supply of high- and low-quality contracts.[2] In this section, we will specify a model that captures the essentials of the mission assignment process for high-quality personnel and describe a test for the endogeneity of this variable.

The U.S. Army Recruiting Command (USAREC) is responsible for selling the Army to perspective candidates. Over the period analyzed in this paper, USAREC was organized into 56 "Recruiting Battalions" with an average of 90 recruiters assigned to each battalion. The command assigns to each battalion monthly goals or targets by market segment (for example, high-school graduates with above average ability scores, etc.). These assignments are the product of a four-step process. The Army Staff in the Pentagon estimates the number of accessions required for each quarter during a fiscal year. USAREC takes these quarterly accession requirements and converts them into quarterly contract requirements by market segment. In the third step, the Operations Staff in USAREC employs three models to predict market potential for high-quality contracts for each battalion and based on these forecasts translates the command's quarterly contract goals into monthly missions for each recruiting battalion. The final step in the mission-assignment process is a face-to-face conference

between the commander of USAREC and individual battalion commanders during which slight adjustments to the initial mission assignments are made.

From a modelling perspective, the key in this process is the third stage. The following three models are used during this stage: a univariate time-series model for each battalion; a regression model estimated using data on battalion performance by month; and, a simple rational-expectations model that attempts to determine the number of contracts that could have been achieved if missions were set within a rational-expectations framework (Wegner, 1991). Presuming that the mission ultimately assigned to a battalion reflects the outcome of these models, we hypothesize that missions are a function of the predetermined variables that appear in these models, plus variables for educational and bonus incentives, fiscal year, and the national mission for that quarter. These latter variable are included to capture the effect of the univariate time-series. Three-month lags are used for all variables whose values would not be known prior to the quarter being forecasted. Essentially, our specification for mission is a reduced form model for high-quality contracts, lagged three months.

Thus, the third equation in our system of equations is

$$\ln(Q_H) = X_{-3}\beta + \epsilon_3 \tag{4}$$

Equations 2-4 form a triangular system of equations. Unless $\mathrm{cov}(\epsilon_3, \epsilon_2) = \mathrm{cov}(\epsilon_3, \epsilon_1) = 0$, Q_H will be correlated with the error terms in equations 2 and 3, and it must be treated as an endogenous variable. In addition, tests of these covariance conditions provide an easy test for whether previous studies have been correct in treating Q_H as exogenous.

Recruiting Regimes, Recruiter Behavior, and Military Labor Supply

Since the inception of quality goals in the early 1980's, the Army has maintained a complementary incentive plan for recruiters. Although the details of the plan have varied, the essential feature has been that recruiters are awarded points for each sale they make and the points vary by recruit type, whether the recruiter achieves his or her overall contract mission, and by whether the recruiting unit has made its mission (Dertouzos (1985), Asch and Karoly (1992)). Based on the number of points the recruiter is able to amass during specified periods, he or she becomes eligible to receive awards such as plaques, badges, gold rings, and certificates. Equation 1 is intended to capture the fundamental features of this incentive system.

Working in conjunction with the formal incentive system are informal and less systematic pressures that are likely to cause a recruiter to value underproduction differently from overproduction. If a recruiter repeatedly fails to make his or her mission for high-quality contracts, there is the implicit threat that the substandard performance can affect the recruiter's annual rating, which is the basis for future promotion decisions in the military personnel system. As a result, achieving the high-quality contract quota is considered essential for career advancement. In addition, the incentives for exceeding mission are mixed because recruiters understand that realizing more contracts than the individual's quota can result in receiving an increased mission over time (Polich, Dertouzos, and Press (1986)).

The recruiting-battalion commander plays an important role that is also likely to affect recruiter behavior. Like recruiters, they too are under intense pressure for their unit to

achieve its high-quality mission and perceive success as being vital to their career. They are able to affect their unit's performance by changing the command climate and judiciously placing pressure on recruiters. Commanders become very active toward the end of a recruiting cycle if they believe the battalion is in reach of its high-quality quota.[3] They accomplish this by "encouraging" selected, experienced recruiters to produce additional recruits. If success is either virtually assured or impossible, they may allow recruiters to hold over recruits for the next month.

The stresses imposed on recruiters by this system are reflected in a 1989 recruiter survey (Maxfield (1990)). According to that survey's results only 32% of the Army's recruiting force volunteered for recruiting duty and only 24% wished to remain on recruiting duty. Furthermore, 84% of the Army's recruiters reported experiencing stress related to efforts to achieve goals and 67% reported that they thought they would be punished if goals were missed. Thus, most Army recruiters are ordinary soldiers who are not professional recruiters and who wish to survive recruiting duty and return to the field Army.

The notion that the marginal utility or value of achieving an additional contract varies smoothly in this environment is a relatively strong assumption. The penalties for under-production appear to be substantially larger than the rewards for over-production (especially for individuals who do not wish to remain recruiters). In addition, the battalion commander establishes the command climate, which determines whether the marginal utility of a recruit is high or low. Because the commander faces many of the same pressures, and it is the battalion's overall performance that is managed by the Recruiting Command, a plausible alternative hypothesis is that the valuation of additional recruits varies with the relative

success being experienced by the recruiting battalion.

Thus, equation 1 may be reinterpreted as the Recruiting Battalion's representative preferences given the incentives that both the battalion commander and the recruiters face. These incentives, being discontinuous in nature, are likely to cause preferences (i.e., the marginal utility of an additional recruit) to vary according to whether the battalion easily succeeds, barely succeeds, or fails to succeed in making its mission. To reflect these observations, we hypothesize that there are three regimes or command climates.

The first regime pertains to the situation in which the battalion's contract achievement is so far below the mission in a given month as to render its accomplishment in the last days of the month highly improbable. In this regime, additional pressure by the commander is unlikely to lead to mission achievement and is, therefore, unlikely to occur. The second regime occurs when the battalion is close to mission achievement. In this situation, the battalion commander is likely to increase the pressure on experienced recruiters and to cause them to increase their valuation of an additional high-quality contract. The third regime occurs when the battalion is already virtually assured of meeting its mission as it enters the final days of a month.

With few exceptions, a recruit does not immediately enter the Army after signing his or her enlistment contract. Rather, the contract will specify an accession date that is linked to the start of whatever training course the recruit will attend. This procedure is known as the Delayed Entry Program, and the pool of recruits who are awaiting induction at any point in time is called the DEP. Some recruits decide not to honor their contract to enter the Army, and this attrition is called DEPloss.

Because mission accomplishment is determined based on contracts signed minus attrition from the DEP (i.e., DEPloss), there is always the potential for surprises at the end of a recruiting month. Thus, a battalion is not assured of making its mission even if it achieves the required number of contracts by type. Thus, DEPloss imparts an added source of randomness in the model that affects the probability of being in any given regime.

Table 2 presents information on the distribution of observations around the mission for high-quality contracts. The tabulation shows realizations of the variable (H-DEPloss-Q_H) where DEPloss is the number of individuals who signed contracts in previous months but failed to report at the time of accession. The fact that the +1 and +2 cells are much more frequent than the -1 and -2 cells is consistent with the idea that commanders are able to induce recruiters to increase production in the neighborhood of the quota. Additionally, the large drop at -2 is consistent with the idea that the high-pressure regime occurs when net achievement (i.e., contracts-DEPloss) is within 2 contracts of the goal. Thus, we will consider an observation to be in the second, or questionable but within reach, regime if the number of high-quality contracts less the high-quality goal less the DEPloss is in the range [-2,2]. Observations above and below this range will assigned to the first and third regimes, respectively.

In terms of the behavioral model depicted in equation 1, the presence of three regimes implies that the δ's differ across regimes, which, in turn, will affect the parameters in equations 2 and 3. Therefore, we are interested in estimating the following model for each of three regimes.

$$
\begin{aligned}
\text{High-quality: } y_1 &= \beta_{12}y_2 + \beta_{13}y_3 + Z_1\gamma_1 + \epsilon_1 \\
\text{Low-quality: } y_2 &= \beta_{23}y_3 + Z_2\gamma_2 + \epsilon_2 \\
\text{Goal: } y_3 &= Z_3\gamma_3 + \epsilon_3
\end{aligned}
\tag{5}
$$

From the preceding discussion, it is clear that the parameters in these equations will vary across regimes. Thus, our analysis of the institutional environment and incentive structure leads to the specification of a switching simultaneous equations system. In describing the estimation of this system, we will draw heavily from the work of Lee (1979).

Statistical Specification

To explain this stochastic switching between regimes, we define an index I, where I takes on values 1,2,3 depending on the regime, and assume that there is an underlying response model which is given as

$$Y_{it} = w_{it}'\alpha + \epsilon_{0it}. \tag{6}$$

Defining $C_0 = -\infty$ and $C_3 = \infty$, an observation belongs to the jth regime ($j=1,2,3$) if $C_{j-1} < Y_{it} \leq C_j$, or equivalently, if $(C_{j-1} - w_{it}'\alpha) < \epsilon_{0it} \leq (C_j - w_{it}'\alpha)$. For the purposes of the regime selection equation, however, we only observe the indicator variable I_{it}.

Assuming that $\epsilon_{0it} \sim N(0,1)$, then

$$\text{Prob}(I_{it} = j) = \Phi(C_j - w_{it}'\alpha) - \Phi(C_{j-1} - w_{it}'\alpha), \ (j=1,2,3),$$

where Φ represents the normal distribution function, and the specification for estimating

α, C_1, and C_2 becomes an ordered probit.

Letting j=1,2,3 index the regimes, then for any observation {it}, we can write the structural model in matrix notation as

$$
\begin{aligned}
B_1 y_{1it} + \Gamma_1 z_{1it} &= \epsilon_{1it} && \textit{iff} && \epsilon_{0it} \le (C_1 - w_{it}'\alpha) \\
B_2 y_{2it} + \Gamma_2 z_{2it} &= \epsilon_{2it} && \textit{iff} && (C_1 - w_{it}'\alpha) < \epsilon_{0it} \le (C_2 - w_{it}'\alpha) \\
B_3 y_{3it} + \Gamma_3 z_{3it} &= \epsilon_{3it} && \textit{iff} && (C_2 - w_{it}'\alpha) < \epsilon_{0it}.
\end{aligned}
\tag{9}
$$

Also, to allow for the possible presence of battalion specific fixed-effects, we will measure all of the variables appearing in equation 7 in deviations from their battalion mean.

Letting $\epsilon_{kit} = (\epsilon_{k1it}, \epsilon_{k2it}, \epsilon_{k3it})'$ represent the vector of structural errors for the kth regime, we assume that ϵ_k is trivariate normally (TVN) distributed with an expected value of zero and a covariance matrix, Σ_k, defined as

$$
\Sigma_k = \begin{bmatrix} \sigma_{k11} & \sigma_{k12} & \sigma_{k13} \\ & \sigma_{k22} & \sigma_{k23} \\ & & \sigma_{k33} \end{bmatrix}
$$

Under these assumptions, ϵ_k and ϵ_0 are quadrivariately normally distributed with $E(\epsilon)=0$ and

$$
\mathrm{cov}(\epsilon_k, \epsilon_0) = \begin{bmatrix} \Sigma_k & \Sigma_{k0} \\ \Sigma'_{k0} & 1 \end{bmatrix},
$$

where $\Sigma_{k0}=(\sigma_{k10},\sigma_{k20},\sigma_{k30})'$.

These distributional assumptions will allow us to exploit the properties of the normal distribution to express the likelihood function in a convenient form. Letting g(.) represent

the joint distribution for ϵ'_{kit} and ϵ_{0it}, we can factor g(.) into a marginal and conditional distribution. That is, after normalizing var(ϵ_0) to 1, we may use the property that the conditional distribution of a normal random variate is normal to write g(.) as

$$g(\epsilon'_{kit}, \epsilon_{0it})' = g_k(\epsilon'_{kit})\, g_0(\epsilon_{0it} \,|\epsilon'_{kit})$$

where

$$g_k \sim \mathrm{TVN}(0, \Sigma_k)\text{, and}$$

$$g_0(\epsilon_0|\epsilon_k) \sim N(\Sigma'_{k0}\Sigma^{-1}{}_k\,\epsilon_{kit},\ 1-\Sigma'_{k0}\Sigma^{-1}{}_k\Sigma_{k0})\,.$$

This allows us to express the joint probability of obtaining a particular observation in the first regime as

$$P(\ \epsilon_{1it},\ \epsilon_{0it}<(C_1-w'\alpha)\ ) = g(\epsilon_{1it}) \int_{-\infty}^{C_1-w'\alpha} g(\epsilon_{0it} \,|\epsilon_{1it})\,.$$

Expressions for the probability of observations in the other regimes may be expressed in a similar manner.

Using the above formulas, the log-likelihood function becomes

$$
\begin{aligned}
&\ln L(B_1,B_2,B_3,\Gamma_1,\Gamma_2,\Gamma_3,\alpha,C_1,C_2,\Sigma_1,\Sigma_2,\Sigma_3,\Sigma_{10},\Sigma_{20},\Sigma_{30}\,|\,y,z,w) = \\
&\sum_{I_{it}=1}\left\{\ln\left[\frac{\mathrm{abs}(|B_1|)}{2\pi\,|\Sigma_1|^{1/2}}\right] + \left\{-\frac{1}{2}(B_1y_{1it}+\Gamma_1z_{1it})'\Sigma_1^{-1}(B_1y_{1it}+\Gamma_1z_{1it})\right\}\right. \\
&\left.+\ln\left[\int_{-\infty}^{C_1-w_{it}'\alpha}\frac{1}{\sqrt{2\pi}\,|1-\Sigma_{10}'\Sigma_1^{-1}\Sigma_{10}|^{1/2}}\exp\left\{-\frac{[\epsilon_{0it}-\Sigma_{10}'\Sigma_1^{-1}(B_1y_{1it}+\Gamma_1z_{1it})]^2}{2(1-\Sigma_{10}'\Sigma_1^{-1}\Sigma_{10})}\right\}d\epsilon_{0it}\right]\right\} \\
&+\sum_{I_{it}=2}\left\{\ln\left[\frac{\mathrm{abs}(|B_2|)}{2\pi\,|\Sigma_2|^{1/2}}\right] + \left\{-\frac{1}{2}(B_2y_{2it}+\Gamma_2z_{2it})'\Sigma_2^{-1}(B_2y_{2it}+\Gamma_2z_{2it})\right\}\right. \qquad (8) \\
&\left.+\ln\left[\int_{C_1-w_{it}'\alpha}^{C_2-w_{it}'\alpha}\frac{1}{\sqrt{2\pi}\,|1-\Sigma_{20}'\Sigma_2^{-1}\Sigma_{20}|^{1/2}}\exp\left\{-\frac{[\epsilon_{0it}-\Sigma_{20}'\Sigma_2^{-1}(B_2y_{2it}+\Gamma_2z_{2it})]^2}{2(1-\Sigma_{20}'\Sigma_2^{-1}\Sigma_{20})}\right\}d\epsilon_{0it}\right]\right\} \\
&+\sum_{I_{it}=3}\left\{\ln\left[\frac{\mathrm{abs}(|B_3|)}{2\pi\,|\Sigma_3|^{1/2}}\right] + \left\{-\frac{1}{2}(B_3y_{3it}+\Gamma_3z_{3it})'\Sigma_3^{-1}(B_3y_{3it}+\Gamma_3z_{3it})\right\}\right. \\
&\left.+\ln\left[\int_{C_2-w_{it}'\alpha}^{\infty}\frac{1}{\sqrt{2\pi}\,|1-\Sigma_{30}'\Sigma_3^{-1}\Sigma_{30}|^{1/2}}\exp\left\{-\frac{[\epsilon_{0it}-\Sigma_{30}'\Sigma_3^{-1}(B_3y_{3it}+\Gamma_3z_{3it})]^2}{2(1-\Sigma_{30}'\Sigma_3^{-1}\Sigma_{30})}\right\}d\epsilon_{0it}\right]\right\}.
\end{aligned}
$$

where the terms $\mathrm{abs}(|B_k|)$ are the Jacobians of the transformation from the ϵ_k to the y_k.

While the above likelihood function could be maximized directly, its complexity and the large number of parameters in our model make such a procedure computationally burdensome. Instead, we maximized the likelihood function by allowing the maximization algorithm to take one step from consistent starting values for the parameters.[4] We employed the algorithm reported in Berndt, et.al. (1974) using analytical derivatives derived from formulas appearing in Dhrymes (1984) to perform this one-step optimization.[5]

II. DATA

The model is estimated using a panel data set we constructed for the purpose of this

study. The data set includes monthly information on the economic environment, demographics, and recruiting resources found in each of 55 recruiting battalions[6] during the period from October 1980 to January 1990.[7] The summary statistics on these variables appear in the appendix.

A key variable that appears in all models of the supply of labor to the military is the alternative civilian wage of potential recruits. Past studies have depended on extremely imprecise measures of or surrogates for this variable. For example, both Polich, Dertouzos, and Press (1986) and Daula and Smith (1985) used manufacturing wages as their measure of civilian opportunities. The use of these variables would be less of a problem if they were highly correlated with the wage opportunities available to potential recruits. Unfortunately, recent research has revealed that wages for older, more skilled workers have risen relative to those of younger, relatively unskilled labor market participants (see Juhn (1992)). Therefore, the use of a variable related to manufacturing wages as a measure of the civilian opportunities of prospective recruits would cause the parameter estimates in military labor supply models to be statistically inconsistent due to errors-in-variables.[8]

To avoid this problem, we construct a wage series for each battalion based on data from the Current Population Surveys. In constructing this alternative wage series we are concerned not only with measurement error, but also with the possibility of simultaneity between the wage variable and military labor supply. While it is unlikely that the number of recruits in any period perceptibly affects the level of civilian wages, the error terms in the labor supply and wage equations may be correlated. Thus, we implicitly have a triangular system with the possibility of simultaneity.

If, for the purposes of illustration, we assume that the military-labor market possessed an equilibrium structure, we have the following system of equations.

$$\ln(H) = \beta_{00} + \beta_{01}\ln(W) + Z_0\gamma_0 + \epsilon_0, \text{ and}$$

$$\ln(W) = X_1\beta_1 + \epsilon_1 ,$$

where H is the number of high-quality enlistments in a recruiting battalion area, W is the wage offered to young men in the corresponding area, and X contains demographic and human capital measures typically found in wage equations, as well as battalion specific constants. If $\mathrm{cov}(\epsilon_0,\epsilon_1) \neq 0$, then simultaneity is a problem. To overcome this problem, the CPS data and enlistment data-base were used to fit a wage equation for each year. By including all of the variables that appear in the enlistment-supply equation, we are able to ensure that the fitted wages are orthogonal to them and, therefore, asymptotically uncorrelated with the error term in that equation.[9]

Fitting yearly wage equations and then applying these estimated equations to calculate the conditional expected-wage for each member of the sample, we constructed a wage series by averaging the fitted values by battalion. This series contains cross-sectional and time-series variation. Table 3 contains a subset of the wage series. For a more complete discussion of the creation of this variable, see Berner (1993).

III. RESULTS

This paper examines two substantive questions regarding the specification of labor supply models for the military: is it correct to treat goals as exogenous variables; and is an equilibrium (or single-regime) framework adequate, or are different recruiting regimes

present in the data? In presenting our empirical results, we will initially focus on the answers to these questions. After examining these specification issues, we will then explore the economic implications of the parameter estimates.

Analysis of the Statistical Specification

The results for the estimation of the three-regime specification are reported in Table 4.[10] Recall that the triangular nature of our structural equations implies that the $\mathrm{cov}(\epsilon_1,\epsilon_3)$ must equal zero for goals to be exogenous. The estimated correlations between the error term in the goal equation and the error terms in the high-quality equations are significant with asymptotic t-statistics ranging from 3.1 to 6.0. Thus, we reject the hypothesis that goals are exogenous.

The theoretical justification for our use of switching simultaneous equations to characterize the recruiting process is weaker and likely to be more controversial than the endogenization of recruiting goals. Therefore, we will examine in greater detail whether the empirical evidence supports this specification. We will evaluate the validity of the specification by examining the consistency between the empirical results and implications of the theoretical model.

Consider the covariance between the error term in the selection equation and the error in the high-quality supply equation. *Ceteris paribus*, a higher value of ϵ_{11it}, the error in the high-quality supply equation, would reduce the probability of being in the first regime. This implies that covariance between ϵ_{11it} and ϵ_{0it}, the error in the selection equation, should be positive. To see this, note that

$$P(\epsilon_{0it} \le C_1 - w_{it}'\alpha \mid \epsilon_{11it}) = \int_{-\infty}^{C_1 - w_{it}'\alpha} \frac{1}{\sqrt{2\pi}} \frac{1}{\sqrt{1-\rho^2}} \frac{1}{\sigma_0} e^{-\frac{1}{2}\left(\frac{\epsilon_0 - \sigma_{01}\frac{\epsilon_{11it}}{\sigma_1^2}}{\sigma_0\sqrt{1-\rho^2}}\right)^2} d\epsilon_0$$

which implies that

$$\frac{\partial P(\epsilon_{0it} \le C_1 - w_{it}'\alpha \mid \epsilon_{11it})}{\partial \epsilon_{11it}} = -\frac{\rho}{(1-\rho)} \frac{1}{\sigma_1\sigma_0} \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{C_1 - w_{it}'\alpha - \sigma_{01}\frac{\epsilon_{11it}}{\sigma_1^2}}{\sigma_0\sqrt{1-\rho^2}}\right)^2} \le 0 \;\; if \;\; \sigma_{01} \ge 0$$

Similarly, for the third regime, a high value of ϵ_{31it} should increase the probability of being in that regime, and a positive partial derivative requires a positive covariance. Our point estimates of these correlations are indeed positive, and we can strongly reject the null hypothesis that they are negative. The asymptotic t-statistics associated with tests for negative correlations between ϵ_1 and ϵ_0 in the first and third regimes are 20 and 14, respectively.[11]

The probability of being in the first regime increases with a larger goal, and the probability of being in the third regime decreases with the goal. As a result, the covariances between the error terms in the selection equation and the goal equation should be negative in the first and third regimes. Once again, the empirical results strongly agree with theoretical predictions. The asymptotic t-statistics for tests for positive covariances between ϵ_0 and ϵ_3 in the first and the third regimes are -22 and -8.5, respectively.

The hypothesis that there is no relationship between regime outcome and the levels of a recruiting organization's high-quality supply or goal would be similarly rejected on the basis of joint hypotheses tests. Calculating the χ^2-test statistic for whether the covariances between the selection equation and the high-quality supply equations are zero results in a

value of 56.3. The test statistic for zero covariance between the selection and the goal and high-quality supply equations is 81.3. These statistics are distributed χ^2_3 and χ^2_6, respectively, and greatly exceed the 1% critical values of 11.3 and 16.8. Finally, a Wald test for the equality of the coefficients in the first and third regimes yields a test statistic of 9036, which is distributed $\chi^2_{(78)}$, and which thoroughly rejects the null hypothesis that the coefficients in the first and third regimes are the same.[12]

In addition to the evidence provided by these statistical tests, the estimated effects of several key variables on regime selection also are consistent with our formulation of the recruiting process. For example, the mechanism that we hypothesize creates this three-regime environment is battalion-commander visits to experienced recruiters who are likely to have at least one recruit whom the recruiter can convince to sign a contract before the end of the month. This process depends critically on the presence of experienced recruiters who have strong contacts in the community and who know when they can convince a recruit to sign. The large positive effect of recruiter experience in the selection equation is consistent with this explanation for behavioral differences across regimes.

Also, the goal setting variables are generally negative and significant in the selection equation. This is expected since increases in them lead to a higher goal, *ceteris paribus*, and therefore are associated with a lower-numbered regime (eg, one instead of two). The principal exception is unemployment, which from its large positive effect in the selection equation appears to be underemphasized in the goal setting process.

In addition to the distributional assumptions, the selection equation is identified by the presence of two variables: a dummy variable capturing whether the recruiting

brigade(-) is supply-constrained (i.e., whether the sum of the high-quality contracts from the <u>other</u> recruiting battalions within a recruiting brigade is less than the sum of their high-quality missions); and a DEPloss variable. The coefficients of these variables are statistically significant in our results. The large negative coefficient on the recruiting brigade(-) dummy variable (-0.779 (0.027)) indicates there are periods when goals, on-average, exceed the capabilities of the recruiting battalions within a brigade.[13] The negative effect of DEPlosses (-0.077 (0.027)) signifies that these losses act like increases in a battalion's mission.

Thus, when examined as whole, the empirical evidence presents a strong case for presuming that the parameters vary across regimes. The selection equation is not independent of either the supply or goal equations, and the interactions between the selection equation and these equations are consistent with a priori expectations. Furthermore, the estimated correlations, particularly the correlations between the selection equation and the high-quality equations in the first and third regimes, are sufficiently large that failing to correct for the censoring that they imply can significantly affect the estimates of the coefficients and the elasticities derived from them. Because policy analyses are often based on these elasticities, the censoring issue has practical as well as theoretical importance.

Analysis of the Goal and High-Quality Contract Equations

Care must be taken when interpreting these results and comparing them to the results from previous studies for several reasons. Because the goals are endogenous in our model, a variable's total effect on supply must be calculated by combining its direct effect in the supply equation with its indirect effect via the goal equation. Also, conditional on the values

of the covariates, a battalion has a positive probability of being in each of the regimes. Therefore, we calculated elasticities by using a weighted average of effects across regimes. Finally, because past studies have found that results are sensitive to unmeasured cross-sectional variation between recruiting battalions (for example, Daula and Smith (1986)), we estimated all of the models in deviations from means format.

Goal Equation

In general, the variables appear to be applied evenly across regimes in setting goals.[14] This is consistent with the use of forecasting models as the starting point in the goal-setting process. The allocation of annual accession goals does vary across regimes, with the third regime receiving the greatest share, *ceteris paribus*. This implies that in the third regime goals rose more than resources and environmental factors would have justified, using the Command's goal setting methodology, but not by as much as they could have.

Unemployment does not have a large effect on missions in either the first or third regimes. This is consistent with its positive coefficient in the selection equation. Relative pay is given much greater weight in the goal-setting process, which is consistent with the large negative effect of lagged pay in the selection equation. Together, these results imply that relative pay is overemphasized in the goal setting process while unemployment is underemphasized. This may reflect a reluctance by the leadership of the Recruiting Command to base goal-setting on short-run cyclical factors, relying instead on more stable cross-sectional variations like those in relative pay.

High-Quality Enlistments Equation

For observations in the second regime, goals have been set so that with hard work the battalion can just achieve its mission. This means that the recruiters have an extra incentive at the end of the month to try hard to persuade the marginal high-quality candidates to sign an enlistment contract. In this regime, therefore, we are seeing the marginal effect of the various policy tools on the decisions of high-quality young men. In this setting, we find that relative pay (0.099 (0.052)) has as strong an influence on supply as unemployment (0.103 (0.033)) and that the enlistment bonus is enormously influential (1.145 (0.135)). Thus, monetary incentives appear to have a powerful effect on marginal enlistments. Also, the relatively large coefficient for the percent-minority variable implies that at the margin it is easier to persuade minority young men to enlist in the Army.

The ordering of the DEPloss coefficients is also exactly what one would expect in these three regimes. Recruiters respond most vigorously to a DEPloss if they are within striking distance (either way) of the goal. There is a somewhat muted response in the first regime, perhaps indicating the presence of some strategic behavior, or perhaps indicating binding supply constraints. Finally, the smallest response occurs in the third regime, where the DEPloss is of little concern to the recruiting-battalion commander. That there is any response at all is probably indicative of the fact that individual recruiters who lose a DEP contract may sign an additional contract, even if they do not have a goal for that month, to offset their DEPloss.

The positive coefficient on low-quality contracts is opposite from our *a priori* expectations. We based our presumption that the coefficient should be negative on the

observation that low- and high-quality contracts compete for recruiter time. Therefore, we would expect a trade-off between them. However, identification of the quality of a candidate at the recruiting station is based on a short screening test; it is only when the candidate is formally tested at the Military Entrance Processing Station that the recruiter knows for sure whether the candidate would be categorized as a high-quality contract. Therefore, there is an element of joint production where the recruiter produces some low-quality contracts while processing what he or she hopes will be high-quality recruits. This explanation is consistent with the relatively larger positive value found in the first regime, which is an environment in which recruiters may be casting their nets widest in the hopes of securing high-quality contracts.

In general, the results we obtain for the effects of various incentives that are within the control of the Army are somewhat anomalous and must be viewed cautiously. In many instances the estimated effects have the wrong sign. These anomalies are probably caused by the endogeneity of these variables, especially the coverage variables for both bonuses and educational incentives. Without a model to explain these variables or identifying instruments, we were unable to control for or test this endogeneity. If we had assumed these variables are influenced by the same variables that affect supply and goals, we could have omitted the coverage variables and viewed the results as a reduced form. However, this approach would have precluded any analysis of the direct effects of other variables on goals and supply, and would have obscured this issue. Furthermore, the effects of flexible incentives, such as funding for post-service education and monetary enlistment bonuses, and the role of advertising have important policy implications. Therefore, we

elected to present a specification that included these variables and to identity their potential endogeneity as an issue deserving further investigation.

Implications of Results and Comparison with Previous Results

Table 5 summarizes the results obtained by previous studies. To facilitate comparison with these previous results, we calculate the elasticity of high-quality enlistments with respect to several policy variables in three different ways. First, for each variable we compute the direct elasticity as the weighted average of the three elasticities in the three high-quality enlistment equations.[15] Secondly, we compute the sum of the direct effect and the indirect effect through the goal setting process. Lastly, we calculate the total elasticity using the reduced-form coefficient obtained from the structural-parameter estimates; the direct+indirect elasticity will differ from the total elasticity because of the impact of the coefficients from the low-quality equation. These elasticities are shown in Table 6. The total elasticities calculated from the reduced form coefficients are most appropriate for policy analysis.

The relative pay and unemployment elasticities have drawn the most attention in previous military manpower studies. The general consensus which emerges from Table 5 is that high-quality enlistments are elastic with respect to relative pay and unitary elastic with respect to unemployment. The total elasticities for relative pay and unemployment which emerge from this study are 0.480 and 0.485, respectively. In all previous studies, the high-quality enlistment goal was taken to be a predetermined variable. This is the first study to endogenize the high-quality goal. Although it is not possible to determine *a priori* the

direction of biases for individual parameters resulting from model misspecification, elasticities from specifications that do not account for the endogeneity of the high-quality goal would be expected to overestimate the relative pay and unemployment elasticities given the positive covariance between the supply and goal variables and the positive relation between these variables and goals. Since pay has the greatest influence on goal, its bias should be larger. Thus, the relationship between our elasticities and those from previous studies are consistent with the differences between specifications.

The production recruiter elasticity of 0.274 is comparable to those in Table 5. The elasticity with respect to national advertising is higher than previous estimates, but the precision of our estimate is low. Therefore, these results raise the possibility that national advertising may exert a more powerful influence on recruiting than previously thought, but they certainly do not provide conclusive evidence of this.

The only other study to estimate elasticities with respect to bonus and educational benefits is Goldberg (1991). Because he combines the (possibly endogenous) coverage and benefit level variables, his estimates of the benefit elasticities are likely to be upward biased. Our results indicate that the effect of bonus benefits is clearly strongly positive and that the educational benefits elasticity is small, negative, and not statistically different from zero. However, the endogeneity issues discussed above make these estimates unreliable for policy analysis.

IV. CONCLUSION

In this paper, we have presented strong evidence that the institutional environment in

which Army recruiting takes place necessitates a switching equation specification of the aggregate labor-supply process. In addition, we showed that the procedures for allocating recruiting goals for high-quality soldiers results in these goals being endogenous to the supply process. Failure to control for these two statistical issues will bias empirical estimates of the labor supply function and result in flawed analyses of resource allocation issues that depend on those parameter estimates.

Overall, we found that labor supply to the Army was positively, but inelastically, related to relative pay and unemployment and that marginal recruits appear to be very sensitive to monetary incentives such as enlistment bonuses. We also found that relative pay is overemphasized during the goal-setting process and that unemployment is underemphasized. In fact, the overemphasis on relative pay during goal-setting is so great that we obtained a negative estimate of its direct (or partial) effect even though its overall effect on supply is significantly positive. If USAREC changes the way it sets goals so the high-quality goal is set approximately correctly for a greater proportion of observations, then these weighted-average elasticities would have to be recalculated with new weights that reflect the probability of being in a particular regime. In fact, any systematic change in the goal-setting process or the incentive mechanism would change the parameter estimates and the empirical supply elasticities.

There remain many areas worthy of further exploration. Some of these can be accomplished only at the expense of others with the current state of knowledge. First, the switching equation formulation relies on the strong assumption of independent observations. An obvious extension of these results would be to extend the specification by allowing

dependent observations. Unfortunately, such an extension presents formidable obstacles because it introduces high order integrals and because of the complexity of the correlation structure associated with movements between regimes over time.

Second, it is possible that the methodology for classifying observations into the three regimes is imperfect. It would be interesting to investigate whether the results are sensitive to our classification rule by estimating the model under the assumption of unknown sample separation.

Third, a more flexible model of the interaction between incentives facing members of the recruiting command and supply variables should be explored. The model used in this paper produces a simple and intuitively plausible specification, but it is restrictive. It is possible that the instabilities we identify that seem to be consistent with a stochastic switch may be the result of non-linear interactions our specification overlooks.

Finally, the estimates of the model point to the possibility that several incentive variables, such as the enlistment bonus coverage and educational benefit coverage variables, may be endogenous. The analysis should be extended to include them in a full information context. Failing that, one would want to account for that possible endogeneity in the present framework. Thus, our results raise as many issues as they resolve, and while much progress has been made in this area over the past decade, much work remains to be accomplished.

Footnotes

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1. In this paper, we adopt DoD's definition of high-quality accessions, which is high-school diploma graduates who score above the 50th percentile on an ability exam administered by the Services.

2. During the 1980's the Army's emphasis on recruiting more high-quality youths caused it to treat the number of low-quality contracts as a slack variable. As a result, the low-quality goal was not allocated among battalions on the basis of technical analysis of market potential but predominantly on the basis of the number of recruiters. Accordingly, it is less likely to be correlated with the error term. Endogenizing the low-quality goal would significantly complicate the estimation with little potential for improving the quality of the results. Therefore, we will focus on the potential endogeneity of the high-quality goal in this paper.

3. This observation is based on conversations with several commanders and personal observations of the behavior of one commander located in the Northeast.

4. We obtained consistent parameter estimates from which to begin the maximization routine by generalizing the procedures described in Lee and Trost (1978), Lee (1981) and Poirer (1981). A detailed description of the formulas and procedures we employed may be obtained from the authors upon request.

5. Derivations of the analytical gradients for this likelihood function may be obtained from the authors upon request.

6. The San Juan, Puerto Rico battalion is excluded because much of the needed data is not available.

7. Because the Army retired one battalion in Oct 1988 by allocating its counties to other battalions, the data set only contains 6090 observations.

8. Among previous studies, only Daula and Smith (1985) attempted to control for the problem of measurement error in the relative wage variable. Using a Durbin instrument, they found some evidence that this is a problem.

9. One issue that arises in this approach is that while the unconditional expected wage is the variable of interest from a theoretical perspective, we only have wage data on those who were employed. This implies that if the above equation applies to the potential wage, the expected value of the error term conditional upon being employed would have a non-zero expectation. Given assumptions about the distribution of the error term in the wage equation, you can obtain consistent estimates of β_1 and form $\ln(\hat{W})=X_1\hat{\beta}_1$, the unconditional expected value. Unfortunately, when we estimated these equations, our estimates were unstable and produced counter-intuitive projections. This instability probably stemmed from having to depend on non-linearity to identify the coefficient of the inverse-Mills ratio. Therefore, in our empirical analysis we will use the projections based on the conditional forecasts of wage opportunities.

10. To conserve space and because they have little policy relevance, this table doesn't report the estimation results for the low-quality equation and the estimates of the coefficients for the

monthly dummy variables that appear in the high-quality equation. Interested readers may obtain the complete set of results from the authors.

11. A similar analysis is not possible for the second regime because the appropriate sign for the partial derivative depends on the position of the observation relative to the limits of integration. As a result, the covariance can not be signed on the basis of theory.

12. We conducted similar tests of parameter stability using a single-regime reduced-form specification and obtained similar results. These estimation and test results may be obtained from the authors upon request.

13. Alternatively, this variable could also imply that supply is affected by the presence of command-wide as well as battalion-specific random shocks. The presence of such shocks would imply cross-battalion correlations. Because inclusion of these affects would significantly increase the complexity of our likelihood function, we leave the exploration of this issue to further study.

14. Our description of the recruiting process technically implies that the parameters in the goal equation should be the same across regimes. But there are also reasons to believe that the parameters in the goal equations will differ across regimes. For example, the adjudication process between the recruiting battalion commanders and the commander of the Army Recruiting Command could impart variations in the relationship between lagged variables and goals across regimes. Imposing this restriction, if it were correct, would theoretically increase the efficiency of our estimates, while imposing it if it were incorrect would lead to inconsistency. A formal test for the stability of parameters in the goal equation across regimes produces a χ^2_{46} statistic of 285.6, which strongly rejects the

hypothesis that the goal-equation coefficients are stable across regimes. We elected not to impose this restriction to maintain the robustness of the estimation procedure.

15. The weights are the percentages of observations in each of the regimes: .467, .135, and .398, respectively. If USAREC changes its goal setting procedures and the percentage of observations in the three regimes changes, these elasticities will have to be recalculated at the new weights.

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Appendix

Summary Statistics for Data,
Three-Regime Switching Simultaneous Equations Model

Total Observations = 5925	Excess Demand Regime (n=2766)		Influential Goal Regime (n=799)		Excess Supply Regime (n=2360)	
Variable	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
High-Quality Enlistments	89.709	31.360	90.692	33.027	99.532	36.867
Low-Quality Enlistments	84.127	34.725	80.493	33.194	91.852	36.177
High-Quality Goal	90.561	31.060	76.305	29.136	74.022	30.864
Brigade (-) Supply-constrained?	0.832	0.374	0.601	0.490	0.316	0.465
High-Quality DEPloss	17.345	9.627	14.289	8.867	11.207	8.473
Low-Quality Goal	38.799	42.869	32.959	39.992	40.921	48.719
Relative Mil-to-Civ Pay	1.510	0.177	1.489	0.188	1.517	0.181
Unemployment Rate	6.748	2.169	6.999	2.337	8.272	2.723
Recruiters	92.979	27.025	85.534	25.748	87.463	25.727
Recruiters w/ >= 9 mos exp.	0.731	0.090	0.741	0.091	0.739	0.098
QMA population	179.594	59.337	170.960	57.663	180.446	57.406
Fraction minority in QMA	0.171	0.110	0.171	0.119	0.164	0.109
Youth Attitudes	0.153	0.045	0.154	0.047	0.149	0.047
Nat'l Advertising (mil 1987 $)	51.744	6.843	52.119	7.195	50.750	6.804
Local advertising (mil 1987 $)	8.542	1.646	8.505	1.500	8.674	1.118
Avg Enlistment Bonus (1987 $)	4240.494	921.779	4111.766	1000.269	4065.306	1233.113
Fraction Eligible for Bonus	0.348	0.093	0.334	0.106	0.285	0.115
Bonus Experiment Dummy	0.184	0.388	0.176	0.381	0.283	0.451
PV of Ed. Benefits (1987 $)	4743.943	400.161	4813.788	415.649	4759.753	435.757
Fraction Eligible for Ed. Ben.	0.670	0.056	0.662	0.052	0.666	0.051
Ed Experiment Dummy	0.039	0.193	0.069	0.253	0.141	0.348
Fiscal Year (Trend)	85.897	2.354	85.605	2.582	84.347	2.657
February	0.078	0.268	0.081	0.274	0.091	0.287
March	0.078	0.269	0.075	0.264	0.092	0.289
April	0.080	0.271	0.100	0.300	0.082	0.274
May	0.104	0.305	0.078	0.268	0.061	0.240
June	0.082	0.274	0.085	0.279	0.085	0.279
July	0.087	0.283	0.100	0.300	0.073	0.260
August	0.085	0.278	0.081	0.274	0.083	0.275
September	0.110	0.313	0.066	0.249	0.058	0.233

Summary Statistics for Data, Three-Regime Switching Simultaneous Equations Model						
Total Observations = 5925	Excess Demand Regime (n=2766)		Influential Goal Regime (n=799)		Excess Supply Regime (n=2360)	
Variable	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
October	0.088	0.283	0.096	0.295	0.073	0.261
November	0.076	0.264	0.080	0.272	0.093	0.291
December	0.063	0.243	0.088	0.283	0.106	0.307
Annual Accession Goal	56632.685	7603.337	54845.620	9127.766	51773.621	11495.270
Relative Pay, lagged	1.493	0.180	1.467	0.192	1.476	0.183
Unemployment Rate, lagged	6.996	2.310	7.078	2.470	8.088	2.609
Recruiters, lagged	44.636	49.469	45.722	46.119	45.633	46.833
Recrtr Exper., lagged	0.348	0.372	0.395	0.377	0.382	0.375
QMA, lagged	180.266	59.365	171.348	57.462	181.225	57.546
Youth Attitudes, lagged	0.152	0.046	0.154	0.047	0.147	0.047
Avg Bonus, lagged	4232.039	963.963	4082.372	1031.143	4010.282	1241.325
Bonus Coverage, lagged	0.335	0.097	0.328	0.112	0.282	0.121
PV of Ed Ben, lagged	4710.234	435.888	4782.310	504.705	4721.536	618.548
Ed Ben Coverage, lagged	0.668	0.057	0.658	0.060	0.659	0.070

Table 1: Thousands of Army High Quality Male Contracts by Fiscal Year														
81	82	83	84	85	86	87	88	89	90	91	92	93[a]	94[a]	95[a]
32.0	46.9	57.0	46.7	55.9	60.5	56.0	49.0	45.9	55.4	45.2	38.2	58.6	55.9	53.6

[a] Figures for Fiscal Years 1993-1995 are forecasts.
Source: U.S. Army Recruiting Command

Table 2: Cell Frequencies for $|(\text{H-DEPloss-Goal})| \leq 7$														
-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7
145	142	146	144	150	132	165	230	221	196	193	194	183	172	124

Table 3: Fitted Weekly Wages, 17-21 Year Old Males Who are not Full Time Students (Real 1990 $/Wk) (Conditional Wage Offers)

Recruiting Area	1981	1982	1983	1984	1985	1986	1987	1988	1989
Albany, NY	195	184	179	187	198	189	215	221	197
Baltimore, MD	214	186	189	190	199	209	213	222	214
Boston, MA	209	194	176	204	223	239	261	260	248
Brunswick, NH	198	186	171	192	209	224	232	240	219
Harrisburg, PA	195	168	159	171	181	176	183	193	189
New Haven, CT	208	194	185	206	223	244	269	271	232
New York, NY	204	184	180	194	198	198	227	237	228
Newburgh, NY	199	179	174	188	199	204	227	224	217
Ft Monmouth, NJ	199	181	174	197	206	210	226	220	.
Philadelphia, PA	200	176	173	192	201	211	226	231	216
Pittsburgh, PA	193	167	154	164	169	166	176	175	181
Syracuse, NY	190	179	164	179	186	178	194	193	201
Atlanta, GA	202	185	176	203	202	212	208	217	215
Beckley, WV	202	174	161	167	154	148	147	143	154
Charlotte, NC	196	180	166	191	201	204	210	210	203
Columbia, SC	194	174	172	196	198	189	196	203	199
Jacksonville, FL	208	187	170	195	196	199	204	206	198
Louisville, KY	200	170	162	174	170	170	157	165	173
Miami, FL	209	189	174	192	200	199	206	201	190
Montgomery, AL	197	180	174	181	183	182	170	159	163
Nashville, TN	192	168	158	170	171	180	175	156	172
Raleigh, NC	197	188	181	195	206	201	205	189	195
Richmond, VA	212	189	194	215	216	206	199	212	199

Table 4: Maximum Likelihood Estimates,
Three Regime Switching Simultaneous Equations Model,
High- and Low-Quality Enlistments and High-Quality Goal Jointly Determined,
(Low-Quality Equations not Reported, Standard Errors in Parentheses)

Value of Loglikelihood: -1355.962 Number of Observations: 5925	Selection Equation	First Regime n = 2766		Second Regime n = 799		Third Regime n = 2360	
Independent Variable	Regime	High	Goal	High	Goal	High	Goal
Log of Male Low-Quality Enlistments		0.595 (0.076)		0.241 (0.057)		0.297 (0.071)	
Log of Male High-Quality Goal		0.469 (0.067)		0.537 (0.052)		0.574 (0.054)	
C1	-0.123 (0.018)						
C2	0.305 (0.025)						
Recruiting Brigade Supply-Constrained in Aggregate?	-0.779 (0.027)						
Log of Male High-Quality DEPloss	-0.077 (0.027)	0.059 (0.006)		0.067 (0.003)		0.028 (0.006)	
Log of Male Low-Quality Goal	-0.088 (0.048)						
Log of Relative Military-to-Civilian Pay	-0.175 (0.266)	-0.155 (0.068)		0.099 (0.052)		-0.075 (0.078)	
Log of Unemployment Rate	1.059 (0.127)	0.304 (0.034)		0.103 (0.033)		0.276 (0.031)	
Log of the Number of Production Recruiters	-0.492 (0.199)	0.073 (0.056)		0.107 (0.035)		0.085 (0.052)	
Fraction of Recruiters with >= 9 Months Experience	0.659 (0.194)	0.109 (0.051)		0.040 (0.031)		-0.110 (0.054)	
Log of Qualified Military Available (QMA) Population	1.951 (0.701)	0.263 (0.150)		0.220 (0.086)		0.308 (0.141)	
Fraction of QMA which is Minority	2.787 (2.688)	0.364 (0.745)		3.189 (0.452)		1.014 (0.587)	
Youth Attitude Tracking Survey	-2.842 (1.254)	-0.630 (0.242)		-0.262 (0.240)		-0.429 (0.258)	
Log of National Advertising Expenditures ($ mil)	-6.288 (0.821)	0.477 (0.141)		0.010 (0.138)		0.136 (0.159)	
Log of Local Advertising Expenditures ($ mil)	3.933 (0.499)	-0.569 (0.103)		-0.303 (0.091)		-0.024 (0.115)	
Log of Average Enlistment Bonus Benefit ($ thou)	-0.970 (0.836)	1.283 (0.181)		1.145 (0.135)		0.160 (0.223)	
Average Fraction of Enlistees Eligible for Bonus	0.415 (1.794)	-3.275 (0.444)		-2.461 (0.337)		-0.705 (0.477)	
Enlistment Bonus Experiment Dummy Variable (7/82-6/84)	0.577 (0.515)	-0.773 (0.104)		-0.652 (0.081)		-0.086 (0.151)	

Table 4: Maximum Likelihood Estimates, Three Regime Switching Simultaneous Equations Model, High- and Low-Quality Enlistments and High-Quality Goal Jointly Determined, (Low-Quality Equations not Reported, Standard Errors in Parentheses)

Value of Loglikelihood: -1355.962 Number of Observations: 5925	Selection Equation	First Regime n = 2766		Second Regime n = 799		Third Regime n = 2360	
Independent Variable	Regime	High	Goal	High	Goal	High	Goal
Log of Present Value of Educational Benefit ($ thou)	7.670 (1.152)	-0.092 (0.177)		0.081 (0.172)		-0.230 (0.269)	
Average Fraction of Enlistees Eligible for Educational Benefit	5.733 (1.545)	-1.926 (0.260)		-1.210 (0.249)		-1.566 (0.439)	
Educational Benefit Experiment Dummy Variable (10/80-9/81)	0.014 (0.480)	-0.428 (0.091)		-0.258 (0.080)		-0.250 (0.121)	
Fiscal Year (trend)	0.452 (0.049)	0.047 (0.009)	0.030 (0.004)	0.019 (0.009)	0.036 (0.006)	0.022 (0.014)	0.027 (0.007)
Log of Annual Accession Goal	-4.090 (0.426)		0.725 (0.039)		0.576 (0.056)		1.128 (0.050)
Log of Relative Military-to-Civilian Pay, Lagged 3 months	-0.840 (0.244)		0.810 (0.052)		0.682 (0.049)		0.732 (0.067)
Log of Unemployment Rate, lagged 3 months	0.294 (0.122)		0.175 (0.025)		0.430 (0.028)		0.271 (0.032)
Log of Production Recruiters, lagged 3 months	-0.142 (0.077)		0.053 (0.018)		0.040 (0.012)		0.089 (0.024)
Recruiter Experience, lagged 3 months	-0.760 (0.225)		0.099 (0.052)		0.157 (0.038)		-0.025 (0.074)
Log of QMA, lagged 3 months	-0.196 (0.635)		0.948 (0.094)		1.342 (0.094)		1.211 (0.130)
Youth attitude Tracking Survey, lagged 3 months	1.515 (1.136)		-0.081 (0.171)		-0.179 (0.236)		0.162 (0.288)
Average Enlistment Bonus Benefit, lagged 3 months	3.182 (0.285)		-0.011 (0.034)		-0.127 (0.048)		-0.309 (0.044)
Average Fraction of Enlistees Eligible for Bonus, lagged 3 months	-2.740 (0.696)		0.152 (0.081)		0.713 (0.131)		0.810 (0.165)
Log of Present Value of Educational Benefit, lagged 3 months	3.134 (0.368)		-0.111 (0.048)		0.112 (0.066)		0.043 (0.072)
Average Fraction of Enlistees Eligible for Ed Benefits, lagged 3 months	-7.296 (0.994)		0.210 (0.116)		0.125 (0.160)		-0.063 (0.199)
Correlation with Selection Equation		0.668 (0.041)	-0.489 (0.026)	0.189 (0.162)	0.158 (0.145)	0.643 (0.057)	-0.303 (0.036)
Correlation Coefficient and Variance, Equation for Goal		0.181 (0.061)	0.032 (0.001)	0.817 (0.246)	0.025 (0.003)	0.235 (0.079)	0.050 (0.002)
Correlation Coefficient, Equations for Low and High		0.285 (0.086)		0.337 (0.175)		0.253 (0.091)	
Variance, Equation for High		0.044 (0.002)		0.017 (0.003)		0.037 (0.003)	

Table 5: Estimates of Elasticities from other Military Manpower Studies

	Daula-Smith Pooled Sample[a]	Polich-Dertouzos-Press[b]	Brown[c]	Goldberg[d]	Daula-Smith Supply-Constrained[a]	Daula-Smith Demand-Constrained[a]
Male Low-Quality Enlistments	-.02 - .11[g]	-.20			+.06 - +.21[g]	-.08 - .17[g]
Male High-Quality Goal	.41	.22		.28		.19
Relative Military to Civilian Pay	.49	-.55[e]	.5 - 1.0	1.2	1.37	.82
Unemployment	.56	.94	.65	.59	1.23	.99
Production Recruiters	.59	.06		.15	.448	.83
National Advertising	.09[f]	.06		.05	.08[f]	.07[f]
Enlistment Bonus	[h]	[h]		-.29	[h]	[h]
Educational Benefits	[i]			.14	[i]	[i]

[a] Daula-Smith (1985). Dependent variable is high-quality contracts. Panel data, recruiting battalion by month, 10/80 - 6/84. Only the results for the Supply-Constrained model account for battalion-specific fixed effects.
[b] Polich-Dertouzos-Press (1986). Dependent variable is high-quality contracts. Panel data, MEPS by month, 7/81 - 6/84. Data are expressed as difference from corresponding month in base period, 7/81 - 6/82. Only 24 monthly observations per MEPS are used.
[c] Brown (1985). Dependent variable is (high-quality contracts)/(high school students). Panel data, states by quarter, 75-82.
[d] Goldberg (1991). Dependent variable is high-quality contracts. Panel data, recruiting battalion by month, 10/80 - 9-88.
[e] Civilian pay only, not relative military to civilian pay.
[f] Impressions, not expenditures.
[g] Daula-Smith (1985) disaggregate low-quality enlistments into two categories: 1-3A Non-high School Graduates, and Other Enlistments (AFQT categories 3B-4). The first estimate shown is for Other Enlistments.
[h] Study has dummy variables for the availability of various bonus benefit programs, but does not estimate and elasticity of supply with respect to bonus benefit levels.
[i] Study has dummy variables for the availability of various educational benefit programs, but does not estimate and elasticity of supply with respect to educational benefit levels.

Table 6: Estimated Elasticities from the Three Regime Switching Simultaneous Equations Model			
	Direct	Direct + Indirect	Total
Low-Quality Enlistments	0.429	0.429	
High-Quality Goal	0.520	0.520	
Relative Pay	-0.089	0.305	0.480
Unemployment	0.266	0.397	0.485
Recruiters	0.082	0.117	0.274
National Advertising	0.278	0.278	0.208
Bonus Benefit	0.817	0.735	0.460
Educational Benefit	-0.124	-0.130	-0.041